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App. No. 10/065,552
Amendment dated March 3, 2005
Reply to Office action of December 3, 2004

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Moreover, new claim 14 is directed to a method of non-invasively profiling "carrier concentration in a semiconductor substrate composed of an In-containing compound and superficially onto which at least one In-containing-compound semiconductor layer has been heteroepitaxially grown."

In order for there to be a "plurality" of epilayers on a semiconductor substrate, by definition at least one of the epitaxially deposited layers must be of a hetero-material foreign to the deposition substrate. When profiling such substrates, as is the case with the present invention, the charge in going beyond a heterointerface collects at the epilayer interface. This is not analogous to profiling a homoepitaxial material such as silicon, as is the case with the subject matter of the Miller disclosure.

Under this section of the Office action, it is alleged that "the applicant has not established the criticality of the voltage." Paragraph [0014] of the present specification, however, does address this issue, explaining, "In terms of an electrochemical C/V technique utilizing an electrolyte electrode as described above, profiling carrier concentration through depths of more than 3 μm is difficult unless a reverse-bias voltage that exceeds 10 V is applied."

Moreover, Miller nowhere teaches or suggests, as is now clearly set forth in claims 1, 6 and 14, "employing applied voltages, including at least a maximum voltage that surpasses 10V, to profile the wafer's C/V characteristics" (or, in the claim 6 instance, "carrier concentration").

Claims 2-3 and 5-6; Miller '489 in view of Endrédi et al. '266

Claims 1 and 4 were rejected as being unpatentable over U.S. Pat. No. 3,803,489 to Miller, in view of U.S. Pat. No. 5,237,266 to Endrédi et al.

The Office action under this section states that Endrédi et al. disclose measuring semiconductor carrier concentration using the "C/V technique," with a liquid contact being "EDTA solution." Nevertheless, Endrédi et al. mention, at column 2, lines 11-17, the difficulty of using the C-V technique to test "structures . . . manufactured from materials containing . . . internal interfaces which cannot follow the measuring frequency, but follow the change in the bias when recording the capacitance-voltage characteristics." And again in column 8, lines 22-24, "The method provided by the present invention is fundamentally different from the (capacitance or conductance measurement) methods known in the art."

Claims 1 and 6 are recited as methods "for profiling[] using the C/V technique," and claim 14 sets forth a "method utilizing a C/V analyzer."

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Furthermore, under this section of the Office action, it is alleged, "the applicant has not established the criticality of the concentration of EDTA," but in paragraph [0028], the present specification states, "The electrolyte 2' preferably contains 80 or more percent by mass EDTA. The reason why is because electrolysis of the water is thereby prevented when high voltage has been applied."

In rejecting claim 6, it is alleged that in the Endrédi technique, the EDTA would "melt" the Ga, but claim 6 does not recite using EDTA to "melt" Ga metal; and it is respectfully pointed out that even if claim 6 did include such a recitation, the claim also recites subsequently solidifying the Ga, which Endrédi makes no mention of.

IDS

It is to be noted that in Applicants' IDS submitted March 2, 2005 in the present application, the technology disclosed in V. Gopal et al. reference etches the profiled semiconductor substrate. Under the section entitled "Theory of Electrochemical Profiling," V. Gopal et al. state, "the semiconductor is electrolytically etched between capacitance measurements, leading to depth profiling. Thus, it is a destructive technique." Further, under the section entitled, "Experiment," cited by the Japanese examiner in the Japanese application that is a counterpart of the present application, V. Gopal et al. state, "The etching and measurement are controlled by the potential across the cell," and add, "The cell has a window facing the sample surface, both to allow the sample to be illuminated during the etch cycle, and to check the sample-electrolyte unction for the presence of gas bubbles."

The present invention, in contrast, needs no such window, as stated in paragraph [0029] of the present specification: "Further, inasmuch as photo-etching is unnecessary in the present invention, the light-receiving window 1b on the cell 1 is not required."